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Construct Accessibility and Eyeblink
—Negativity Bias of Accessibility in Depression—

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Abstract

Information processing approaches of depression in social psychology have argued that a depressed person has stronger links between node of self and those of constructs with negative valence in his or her associative network of memory, thus such negative constructs become more accessible during self-reference information processing. Behavioral measures used in previous experimental studies on the problem, however, could not reflect directly the internal steps of processing. This study tried to assess the construct accessibility using eyeblink response measured in a discrete trial paradigm in which depressed and nondepressed subjects conducted a self-reference task for positive and negative trait adjectives. The eyeblink was suppressed before and during presentation of stimuli and a burst pattern of the eyeblink was observed just after it. Results of this study suggested that the pattern of the eyeblink burst after stimuli could reflect cognitive effort, cognitive load, or amount of attentional resource, therefore construct accessibility could assessed by using the eyeblink response as a measure.

Introduction

The notion of "construct (or category) accessibility" was first proposed by Bruner (1957) and still has been a key concept for understanding mechanisms of social cognitive processes. Kelly (1955) reasoned that individuals have systems of categories or trait dimensions to evaluate their environments or other people and called the categories "constructs". Although individuals store many such constructs in their memory, they can use only a limited number of the constructs when they form impressions of others because of restriction of cognitive resource. Constructs with high accessibility will be easily used in the impression formation processing. Also, the evaluaters will tend to assimilate their impressions and evaluations of a target person to the highly accessible constructs. It has been suggested that the construct accessibility can be changed by both permanent or chronic factors and temporary factors (e.g., for a review, Wyer & Carlston, 1994).

Recently, information processing approaches to depression in cognitive social psychology have argued that information processing systems are negatively biased in depressed persons (for a review, Moretti & Show, 1989). Some theorists have maintained that one of the reasons of such a negativity bias in depressive cognition is higher accessibility in constructs with depressive contents or affectively negative valence. For example, network models of emotion (e.g., Bower, 1981; 1991; Ingram, 1984) have predicted that various feeling states including depressive mood, as well as other information units, are represented in a memory system and are linked to related conceptual or factual nodes by associative pathways. The experience of a mood activates its representational node and further the activation will be spread to other conceptual constructs which are assumed to be relatively permanent components of one's perceptual structure linked to that mood, facilitating their retrieval and use in subsequent cognitive processing. Thus, depressed individuals who chronically experience a depressive mood are more likely to use depressive or evaluatively negative constructs to process information about persons or environments, resulting in that they are apt to have more negative impressions, thoughts, or cognitive outputs concerning their circumstances.

Some researchers have showed that depressed persons' negative bias is specific to the perception of self-referent information and not so much in more general social perception (e.g., Rhodewalt & Agustsdottir, 1986; Pyszczynski, Holt, & Greenberg, 1987; Pietromonaco & Markus, 1985). To explain this self-referent effect of negativity bias in depressive information processing, Bargh and Tota (1988) amended the associative network models. They argued that self is also represented as a node in the assosiative network and connected to nodes of constructs. Connections between the node of self and those of depressive constructs in depressed persons are stronger than those in nondepressed persons. On the other hand, nondepressed persons have stronger links between the node of self and those of nondepressive constructs than depressed persons (see Fig.1.). The activation spreading is more easily happened along stronger linked pathways than weaker linked pathways. Thus, once the node of self is activated, the accessibility of depressive constructs will become higher than that of nondepressive constructs in depressed persons and resulting in facilitating processing about negative information about themselves and evaluating themselves more negatively.

Bargh and Tota (1988) examined this reasoning in an experiment using a kind of reaction time (RT) paradigm in a self-reference and other-reference judgment task. They showed that depressed subjects processed and reacted to depression related trait adjectives only in the self-reference task in which they were asked to answer whether each adjective described themselves or not even when they were burdened a memory load, but not in the other-reference task in which they answered whether each adjective described general other persons. Bargh and Tota (1988) concluded that the negative constructs with high accessibility automatically worked in processing of negative information about self. Although this work is inspiring, some limitation of the RT paradigm

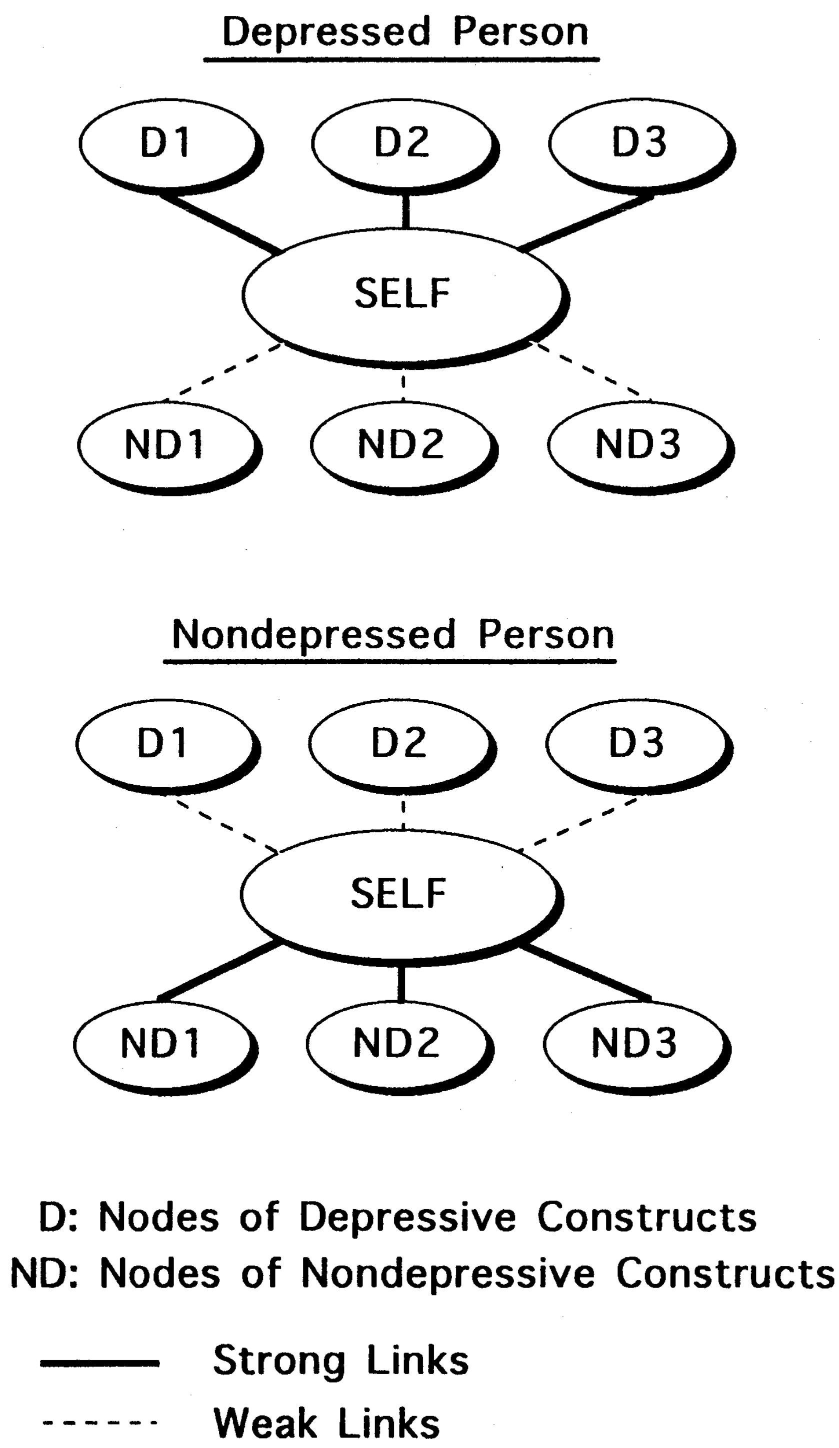

Fig. 1. Model of self-structures of depressed and nondepressed persons

must be recognized. The RT is affected not only by construct accessibility but also by many other variables because it is the final output through several information processing stages, namely activation of the node of self, recognizing of trait adjectives, matching between the concepts of self or of others and those of the trait adjectives, judgment of answer, and motor response to answer. Therefore, even if difference between RT in each experimental condition was found, which stages of information processing evoked the RT difference was not clear.

The purpose of this study is to examine more clearly effects of construct accessibility in the self related information processing by using a new measure, that is, eyeblink response. Research for five decades has shown that the eyeblink activity is affected not only by physical factors but also by psychological states, such as information processing, attention, arousal, motivation, and emotion (for a review, Stern, Walrath, & Goldstein, 1984). Altough traditionally the eyeblink activity has been evaluated by measuring the rate of eyeblinks or the number of eyeblinks during a relatively long period of time, a new method named "discrete trial paradigm" in which the temporal distribution of blinks evoked by some stimuli was proposed (Stern, et al., 1984). Studies using this paradigm have indicated that there exists a close relationship between eyeblinks and cognitive processes. For example, Fukuda and Matsunaga (1983) measured subjects' eyeblinks during a series of signal discrimination tasks in both visual and auditory modality. They reported that the eyeblink rate was suppressed just before stimulus presentation, peaked just after the stimulus, and then progressively decreased untill the next stimulus in each modality task. Furthermore, the hight of the peaks just after stimulus presentation corresponded to cognitive load in the tasks. Fukuda and Matsunaga (1983) explained this pattern of the blink rate by hypothesizing that eyeblinks tend to be inhibited during activities of some cognitive processes and a burst of eyeblinks is initiated upon the termination of the stages of information processing.

If this reasoning is true, the eyeblink rate measured in the discrete trial paradigm might be a potentially useful measure also for such a research area in which cognitive processes for social stimuli are examined based on the frame of information processing perspectives. Especially the eyeblink activity, instead of the traditional RT measure, might be useful for evaluating time which is needed to process some social information or the amount of attentional resource which is allocated to process the stimuli. In the present study, depressed and nondepressed subjects' eyeblinks were measured during a self-reference judgment task of some trait adjectives. Based on the experiment of Fukuda and Matsunaga (1983), a series of stimuli, namely, a fixation stimulus, trait adjectives, and a Go-signal was presented to the subjects.

If the eyeblink activity reflects real time processing of information, the same pattern of the change of the eyeblink rate as the study of Fukuda and Matsunaga (1983) that is inhibition of the blink before presentation of each stimulus and a peak of it just after the stimuli. Characteristics concerning the peak just after trait adjectives are considered to be different between the depressed and nondepressed subjects. Depressed individuals, because of their high accessibility in negative valenced constructs, are considered to take less time for perception and evaluation of negative trait adjectives, whereas nondepressed counterpart would access more quickly to positive stimuli. Hence the depressed individuals would show shorter latencies of the eyeblink rate peak after negative adjectives than positive ones. The latencies of the blink rate peak in the nondepressed individuals, on the other hand, would be shorter after positive stimuli than negative ones. Furthermore, more attentional resource or cognitive effort would have to be allocated to process trait adjectives whose accessibility is low. Therefore, the peak would be higher after positive stimuli than negative ones in the depressed individuals and the reversed pattern would be shown in the nondepressed ones.

Also, as Fukuda and Matsunaga (1983) suggested, if hight of an eyeblink rate peak just after a stimulus represents the amount of attentional resource allocated to processing of the stimulus, it would be predicted that there would exist differences in hight of the eyeblink rate peaks as a function of depression and trait adjectives. Trait adjectives with higher accessiblity will be processed relatively more automatically and thus need less attentional resource. Based upon the speculation of Fukuda and Matsunaga (1983) that a cognitive load facilitates the hight of the peak, less accessible trait adjectives which reqire more attentional resource would be predicted to evoke higher peaks of eysblink rate. Therefore, higher peaks would be observed just after positive valenced words in the depressed group and negative valenced words in the nondepressed group.

Method

Subjects Seven depressed and 9 nondepressed female undergraduate students in Tokai Women's College participated in the experiment. They were chosen on the basis of their scores on a Japanese version of the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), which was administered to 280 students in the college. The selection criterion for depression was a score of 30 or above, and for nondepression was a score of 0 or 1.

Each participant was asked to complete the BDI again at the end of the experimental session to ensure that she still met the criteria for depression or nondepression. Altough some subjects' scores shifted in both groups, data of all the subjects were analyzed because each depressive subject's score at her experiment session was above 14, which indicated mild depression in Beck's standard (Beck, 1976), and each nondepressive subject's score at the session was below the minimum standard for mild depression (BDI=10). The means of scores of subjects were 23.43 (SD=6.95) for the depression group, and 3.67 (SD=2.62) for the nondepression group. All participants were native Japanese with normal or corrected-to-normal vision.

Materials Twenty evaluatively positive toned and 20 evaluatively negative toned trait adjectives which were written in katakana, Japanese letters and matched for length were presented as stimuli. One half of both positive and negative words was semantically related to depression and the other half was irrelevant to it. Stimulus words were presented to the subjects through a 3ch tachistoscope (Takei, Inc., DP-6) within a visual field of $7^\circ \times 4^\circ$.

Recording and quantification of blink data The eyeblink was measured by a pair of electrodes placed above and below the subjects' right eye (EOG). Intertrial intervals were divided into .3 s periods and the average number of blinks in each period for each block of stimulus words (depression related positive, depression irrelevant positive, depression related negative, and depression irrelevant negative) was determined.

Procedure The subjects were seated in the same shielded chamber and presented a series of visual stimuli which were arranged as S_1, S_2, and S_3; S_1 was the fixation-warning stimulus, S_2 was trait adjective, and S_3 was the Go-signal for the motor response for answer (see Fig.2.). A black dot was used as S_1 and S_3. In each trial, after an intertrial

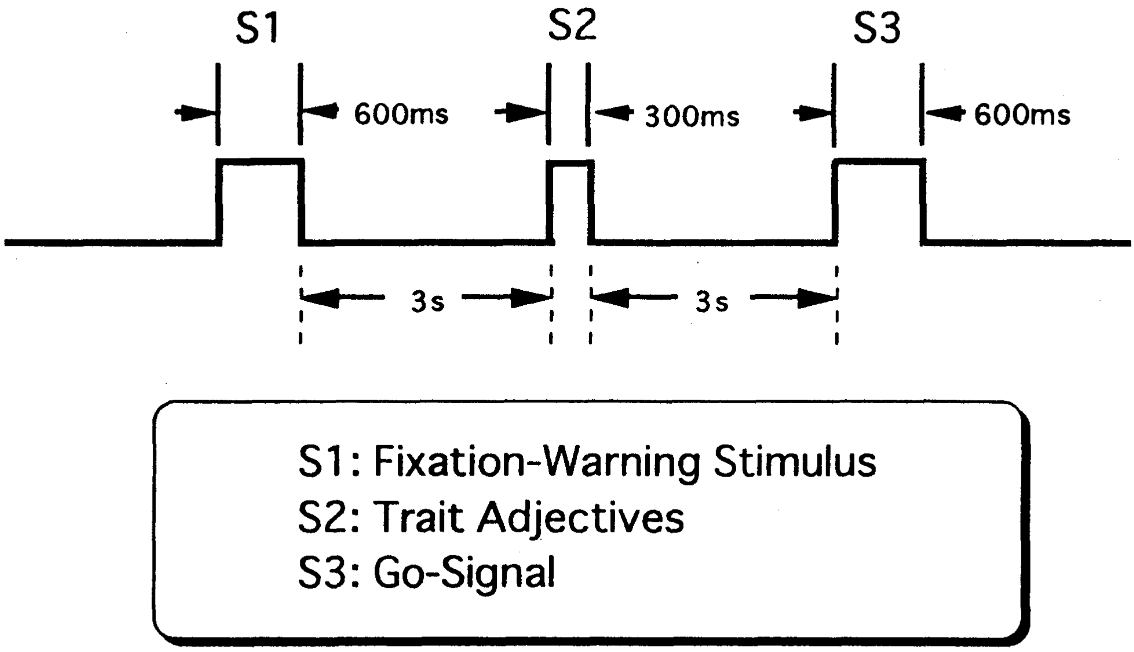

Fig. 2. Procedure of stimulus presentation

interval of about 10s, the S_1 was presented for 600ms and the S_2 was presented for 300ms at 3s after of the S_1. Furthermore, the S_3 was presented for 600ms 3s after the S_2. The subjects was asked to answer whether each adjective described themselves or not by pressing as quickly and accurately as possible a 'yes' or 'no' button on a response box when the S_3 was presented. During trials, EOG was recorded continuously, and RT for the S_3, and response ('yes' or 'no') for each trait adjective were measured.

Results

Responses to stimulus words As shown in Table 1, the depressed subjects confirmed 74.3% of the negative trait adjectives related to depression ($M=7.43$) as self descriptive,

Table 1 Response to trait adjectives

Trait adjective	DP-related negative		DP-nonrelated negative		DP-related positive		DP-nonrelated positive	
	Yes	No	Yes	No	Yes	No	Yes	No
Depressed	7.43	2.57	6.43	3.57	3.71	6.29	4.86	5.14
Nondepressed	3.00	6.90	3.44	6.56	5.44	4.56	9.89	0.11

and the nondepressed subjects confirmed 30.0% of those ($M=3.00$). The depressed also answered 'yes' to 64.3% of the negative trait adjectives irrelevant to depression ($M=6.43$) and the nondepressed did to 34.4% of those ($M=3.44$). As concerning the positive trait adjectives, the depressed subjects confirmed 53.0% of the depression related ones ($M=3.71$) and 37.4% of the depression nonrelated ones ($M=4.86$) as self descriptive, on the other hand, the nondepressed subjects did 77.7% of the former ones ($M=5.44$) and 76.1% of the later ones ($M=9.89$). A repeated-measures ANOVA, with depression (depression vs. nondepression) the between subject factor and trait adjectives (depression related negative, depression irrelevant negative, depression related positive, or depression irrelevant positive) the within subject factor revealed a highly significant interaction indicating that the depressed subjects confirmed more negative adjectives and less positive ones as self descriptive than the nondepressed subjects ($F(3/42)=25.96$, $P<.001$).
Eyeblink rate Fig.3. shows an example of eyeblink recording. Eyeblink bursts are shown after stimuli. The changes of the eyeblink rate in the positive and the negative trait adjective conditions in both the depression and the nondepression groups are shown in Fig.4. The blink rate in each condition clearly peaked just after S1, S2, and S3, respectively, and details of the form of each peak were different between groups. The post-S_1 and the post-S_2 peaks in the depression group seemed to be higher than those in the nondepression group, and dual peaks were found after the S2 in both groups. Such dual peaks were also observed in the depression group and not found in the nondepression group after S3. Fig.5. and Fig.6. show the changes of the blink rate in four conditions of the trait adjectives (depression related negative, depression irrelevant negative, depression related positive, and depression irrelevant positive) in each experimental group.

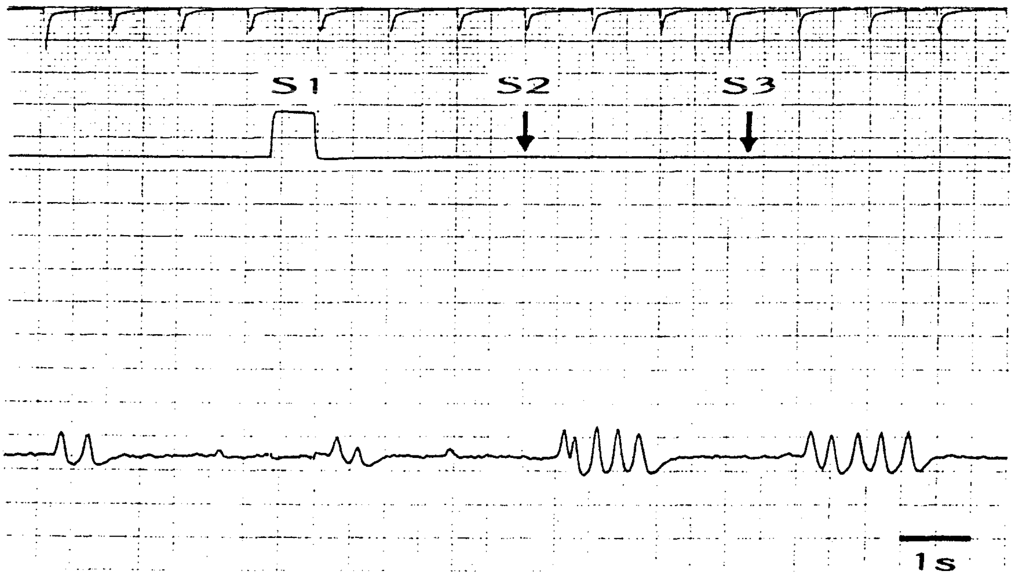

Fig. 3. Typical example of eyeblink recording

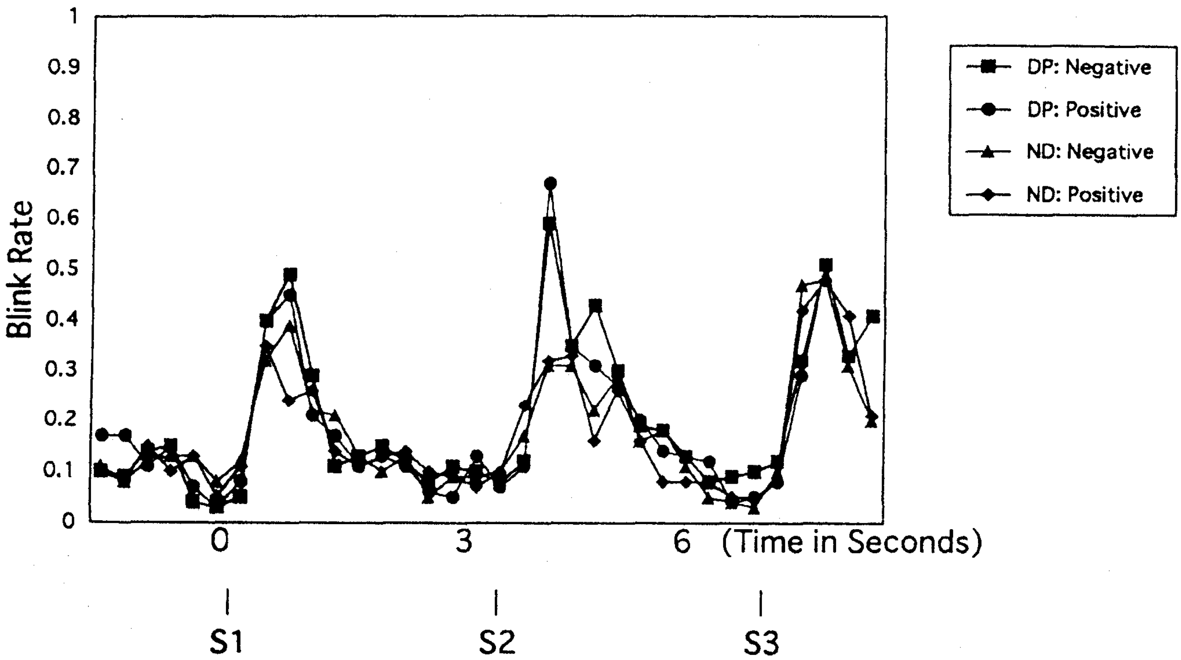

Fig. 4. Changes of eyeblink rate in depressed and nondepressed groups

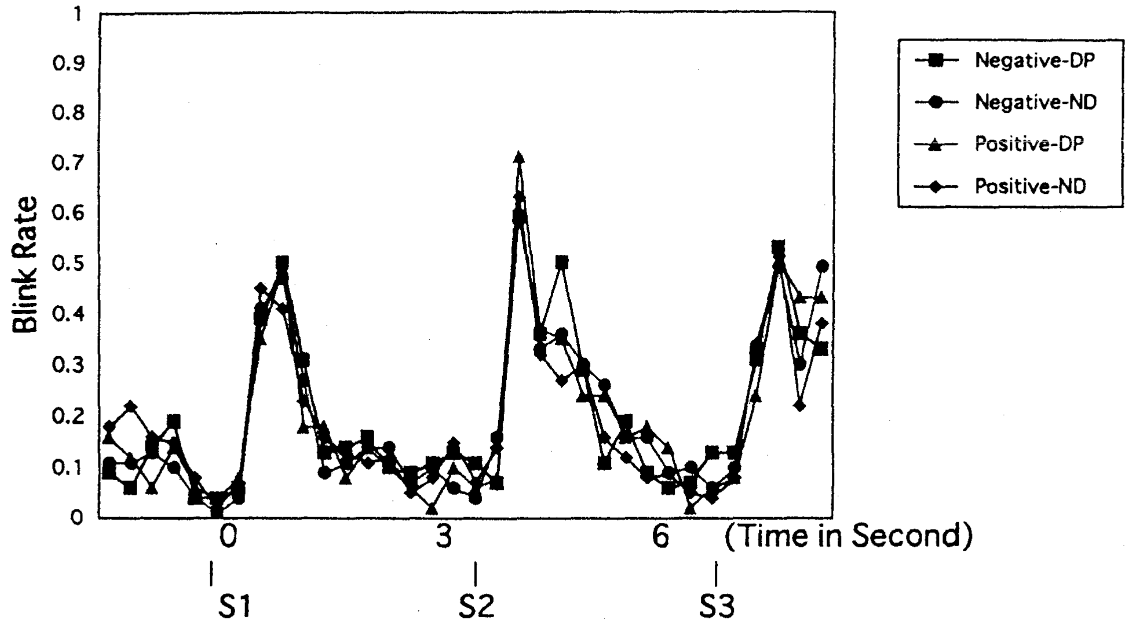

Fig. 5. Changes of eyeblink rate as a function of trait adjective in depressed group

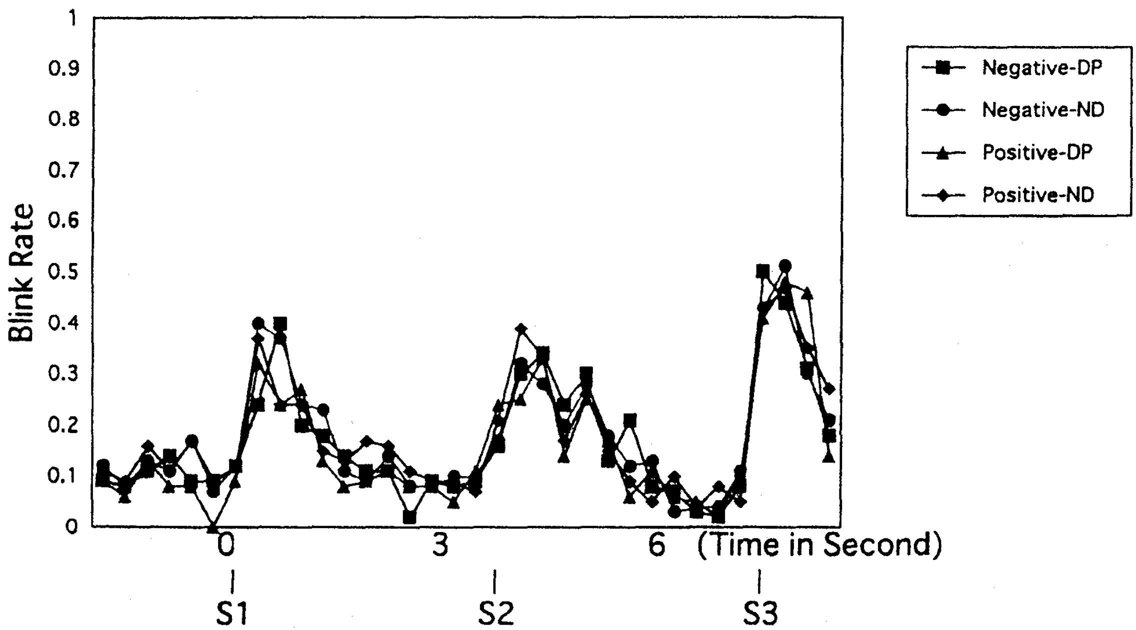

Fig. 6. Changes of eyeblink rate as a function of trait adjective in nondepressed group

The blink rate in each .3s period was subjected to a repeated-measures ANOVA, with depression (depression vs. nondepression) the between subject factor and trait adjectives (depression related negative, depression irrelevant negative, depression related positive, or depression irrelevant positive) the within subject factor. Concerning the post -S_1 peak, a statistically significant interaction between depression and trait adjectives was found in after 900ms-1200ms period from S_1 ($F(3/42)=4.26$, $P<.05$) and further analyses revealed that the blink rates in two positive adjective conditions in the nondepression group were lower than those of other conditions. About the post-S_2 peak, a main effect of depression ($F(1/14)=2.90$, $P<.10$) and an interaction between depression and trait adjectives ($F(3/42)=2.36$, $P<.10$) approached to a statistically significant level in after 600ms-900ms period from S_2. Simple main effect analyses ($P<.10$) revealed that the blink rates in the depression group were higher than those of the nondepression group, also positive adjectives related to depression elicited higher peak than the other adjectives only in the depression group. Furthermore, significant main effects of depression ($F(1/14)=4.19$, $P<.05$) and of trait adjectives ($F(3/42)=3.66$, $P<.05$) were observed in after 1200ms-1500ms period from S_2, indicating that the depressed subjects had higher bink rates than the nondepressed subjects and positive adjectives related to depression elicited higher peak than the other adjectives in the depression group ($P<.05$). The post-S_3 peaks were also different between groups. The higher blink rates were found in the depression group than in the nondepression group in after 1500ms-1800ms period from S_3 ($F(1/14)=10.53$, $P<.01$).

Reaction time Mean RT to S_3 in each experimental condition is shown in Table 2. An

Table 2 Reaction time to S3(ms)

Trait	Negative		Positive	
adjective	Yes	No	Yes	No
Depressed	975.36	1201.76	952.87	1107.97
Nondepressed	881.21	838.11	887.26	900.38

ANOVA was conducted and the interaction between depression and trait adjectives approached to a significant level ($F(3/42)=2.13$, $P<.10$). It suggested that the depressed subjects reacted more slowly to S3 than the nondepressed, especially when they answered 'no'.

Discussion

Results of the present experiment clearly showed that the eyeblink rate changed corresponding to onset of a series of stimuli. In both the depressed subjects and the nondepressed ones, the eyeblink rate decreaced before and during presentation of each stimulus namely fixation, trait adjectives, and Go-signal and peaked just after it. This pattern of the eyeblink rate was strictly the same as that in the previous study (Fukuda & Matsunaga, 1983) in which simpler stimuli and tasks were used. Hence it seems rational to consider that the eyeblink inhibition during perception or evaluation period of stimuli and the burst of eyeblink just after it is a robust phenomenon even in processing of social information.

The peak of eyeblink rate just after trait adjectives was quite different from the other two peaks and between the depressed group and the nondepressed group. Contrary to the hypothesis, there did not exist differences between latencies of the peaks to positive adjectives and negative ones both in the depressed and the nondepressed group. However, some interesting patterns were observed. First, a sharp and high peak was found in the depressed group, on the other hand the peak in the nondepressed group was remarkablly low. These differences are considered to be caused by the differences of information processing upon the trait adjectives between the two groups. Namely, the higher peak in the depressed group might be elicited by allocation of more attentional resource to conduct self-reference judgment than that in the nondepressed subjects. It has been widely argued that both automatic processing and controlled processing work in information processing (Bargh, 1994). Because depressed persons might have some dysfunctionings in their automatic processing, they might have to allocate more resource to conduct processing of trait adjectives than nondepressed persons. This speculation is partly supported by the fact that the depression related positive adjectives which seemed to be the least self-schematic and have less accessibility for the depressed persons elicited the highest peak and even the depression irrelevant positive words evoked higher peak than the negative words which might have stronger links with the node of self in the depressed group. This variation of the hight of eyeblink rate peaks clearly corresponds to cognitive effeort, cognitive load, or the amount of attentional resource. Also this pattern is compatible with the finding of Fukuda and Matsunaga (1983).

Dual peaks were found in the eyeblink rate both to the positive and the negative adjectives in the nondepressed subjects whereas the such a dual peak pattern was found only to the negative adjectives in the depressed subjects. These two peaks might indicate termination of the two different stages of information processing. For example, the first peak might indicate the end of evaluation of a trait adjective and the second peak might show the termination of the matching between the concept of self and that of the adjective. Although the reason why the second peak to the positive adjectives was not found in the depressed group was not clear, one of possible explanations is that the eyeblinks were not syncronized upon the termination of the matching stage because the time which was needed to match between self and the construct depended on the stimulus words and thus made wide variation in latencies of eyeblink rate peaks concerning positive adjectives. On the other hand, the depression related negative trait adjectives took only short time for the depressed resulting in synchorny of the end of the matching stage.

These findings seem to support the reasoning that the eyeblink activity shold at least partly reflect accessibility of constructs which are corresponding to concepts of the stimulus words.

The patterns of the peaks just after the Go-signal were also different between the two group. A clear dual peak was found in the depressed group whereas a single peak was found in the nondepressed one. This is considered to be caused by the difference of RT to the Go-signal. In spite of statistically marginal difference of RTs between the two groups, the mean RT was slower in the depressed group than in the nondepressed. The mean RT in the depressed group was 1059 ms and the eyeblink rate decreaced remarkably in 900-1200ms period after the Go-signal. Recently, Fukuda (1994) showed that the eyeblink is inhibited during motor action and facilitated both just before and just after it. The dual peak found in the depressed group is interpreted as bursts of blinks before and after their motor responses of pressing the key to answer. This result shows the validity of the experimental paradigm used in this study in which evaluation of stimuli and motor responses to them were separated to avoid interference of key pressing with the eyeblink related to processing of stimulus words.

This study was the first trial in which the eyeblink activity was applied for examining the characteristics of depressed persons' self-reference cognitive processes. Altough there remain some problems to be solved, it was shown that the eyeblink measured in the discrete trial paradigm would be a useful tool to assess the construct accessibility. By using both behavioral and the eyeblink measures, we might be able to examine more clearely the notion of the construct accessibility which has not been evaluated directly in the previous research.

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